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Dual-wavelength Interdigital Capacitive Sensor for Dielectric Material Detection

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Interdigital capacitive sensors are widely used for non-destructive measurement of dielectric material properties in industry, with the advantages of one-sided inspection, adjustable signal strength and tomography capability. The dual-wavelength interdigital capacitive sensor has dual penetration depth, can be used for inspection material properties at different depths from the surface (Figure 1). In order to improve the imaging quality of capacitive sensor systems and enhance the inspection accuracy, the structure parameters optimization of the sensor and the edge-detection algorithm is studied. An analysis of how the sensor unit parameters affect the performances, such as the sensitive field distribution, sensitivity, and signal strength is presented. The interpolation algorithm and Canny Operator edge-detection is also studied. For example with the two-layer damaged dielectric material, the area is 240 × 240 mm^2, the thickness of the first and the second layer are 0.35 mm, 0.3mm respectively. The relative permittivity of the first and the second layer are 3 and 6.The dual-wavelength sensor (Figure 2) is designed for the damage detection and the simulation is conducted. The results show that the damages in different layer can be detected effectively.

Acknowledgement:

This work is supported by the China Scholarship Fund (No.201406695031).

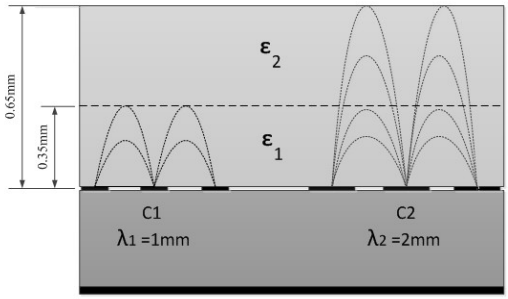

Figure 1. The measurement model for dual-wavelength sensor.

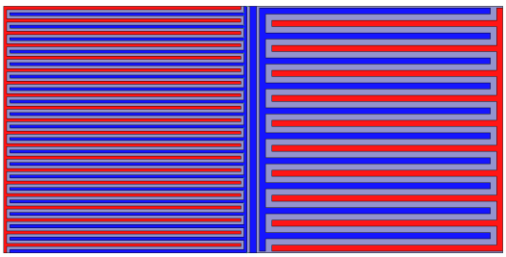

Figure 2. Dual-wavelength Interdigital capacitive sensor; the wavelength of sensor unit are 1 mm and 2mm respectively.